5.9 GHz DSRC OPERATIONAL CONCEPT INTRODUCTION

5.9 GHz DSRC (Dedicated Short Range Communications) is a short to medium range communications service that supports both Public Safety and Private operations in roadside to vehicle and vehicle to vehicle communication environments.

It is one of the most effective means to deliver rapidly changing information that is time and location dependent. DSRC can be used anywhere timely delivery of data is required.

DSRC can be added to "Dynamic Message Signs" and "Highway Advisory Radio" to broadcasting localized traffic or road information directly into the vehicle. No driver action is required to receive DSRC messages.

Traffic information is enhanced by using DSRC to collect vehicle link times and deliver this local traffic information back to all the participating vehicles.

Many applications can only be implemented with wireless communications. These include "Emergency vehicle approach warning", "Impending collision warning", "Open road tolling", among many others.

DSRC enhances the delivery of traffic and road information to the public like electronic tolling enhances the throughput and efficiency of toll operations.

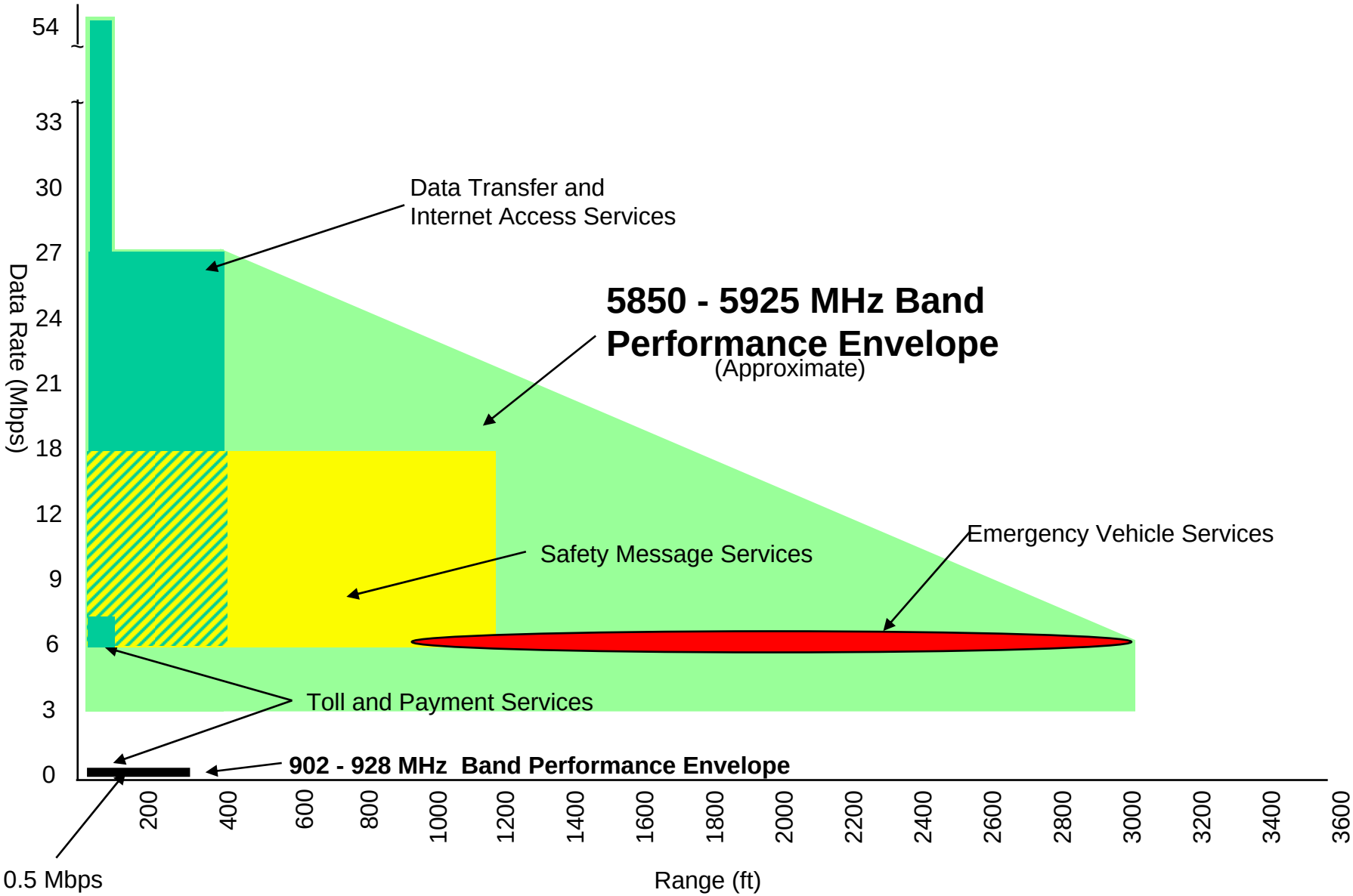
5.9 GHz DSRC CAPABILITIES

PARAMETERS	5850 - 5925 MHz Band
SPECTRUM USED	75 MHz
DATA RATE	6 Mbps - 27 Mbps
COVERAGE	Overlapping communication zones
ALLOCATION STATUS	Co-Primary Status (high protection)
INTERFERENCE POTENTIAL	Sparsely located Military Radars, Sparsely located Satellite Uplinks
MAXIMUM RANGE	1000 m (~ 3000 ft)
MINIMUM SEPARATION	50 ft (on small zone channels)
CHANNEL CAPACITY	7 channels
POWER (Downlink)	Nominally less than 33 dBm (2 W)*
POWER (Uplink)	Nominally less than 33 dBm (2 W)*

ITS RADIO SERVICE is the FCC Part 90 designation for the 915 MHz and 5.9 GHz DSRC spectrum
*Note - As a special case up to 44.77 dBm (30 W) may be use for qualified public safety applications.

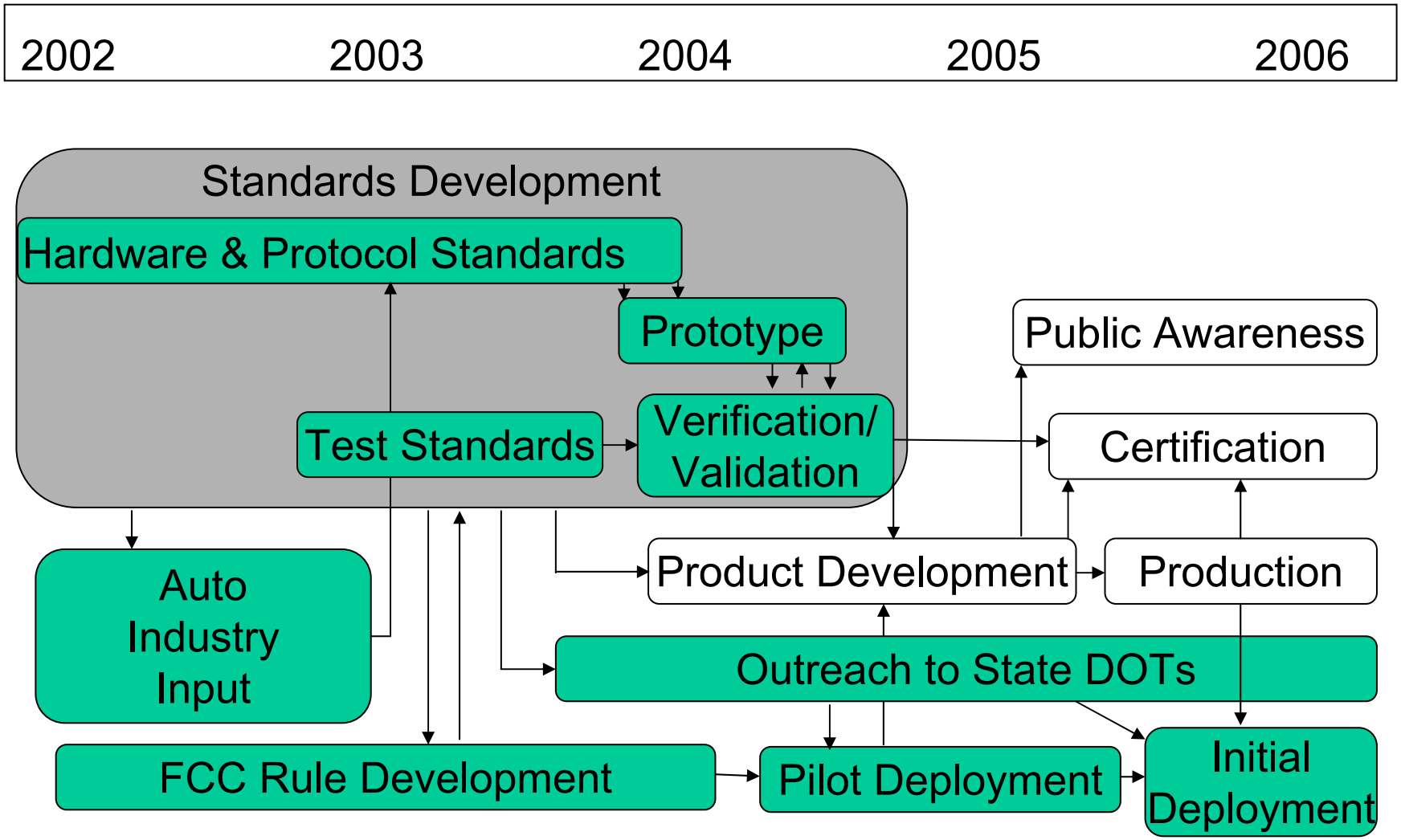
Courtesy DRSC

DSRC PERFORMANCE ENVELOPES



Courtesy DRSC

5.9 GHz DSRC DEVELOPMENT SCHEDULE



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5.9 GHz DSRC APPLICATION USERS

- **DEPARTMENTS of TRANSPORTATION**
- **POLICE and FIRE DEPARTMENTS**
- **VEHICLE MANUFACTURERS**
- **COMMERCIAL VEHICLE OPERATIONS**
- **TRANSIT AGENCIES (BUSES)**
- **RAIL RAPID TRANSIT SYSTEMS**
- **PRIVATE OR CORPORATE**

Courtesy DRSC

DSRC APPLICATIONS
POLICE and FIRE DEPARTMENTS

- **EMERGENCY VEHICLE APPROACH WARNING**
- **EMERGENCY VEHICLE SIGNAL PREEMPTION**
- **IMMINENT COLLISION WARNING**
- **ROLLOVER WARNING**
- **HIGHWAY/RAIL [RAILROAD] COLLISION AVOIDANCE**
- **COOPERATIVE COLLISION WARNING [V-V]**
- **TRAFFIC INFORMATION – [Based on DATA COLLECTED from PROBES]**
- **HOT SPOTS – High Data Rate DOWNLOADS from CENTRAL DATABASES**
  - **Pictures**
  - **Finger prints**
  - **Search Information**
  - **NCIC DATA**
- **VIDEO UPLOADS AND VIDEO RELAYS**
- **ACCESS CONTROL and OTHERS**

Courtesy DRSC

IEEE 802 11-04-0121-00-WAVE Background Information.ppt

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USE CASES WE WILL CONSIDER

- We consider the following to be the complete list of public safety use cases for this project:
  - Vehicle Approach/Stopped Vehicle Warning
    - Vehicle Approach/Stopped Vehicle Warning – RSU/OBU Relay
  - Signal Preemption/Prioritization
  - Temporarily Designated Emergency Vehicle
  - Data Networking At Emergency Scene

USE CASE CHARACTORISTICS

- We formally state this property of public safety applications as follows:
  - Public safety applications **need to be turned on and off**. Unlike vehicle safety applications, which ideally should run all the time without user intervention, public safety applications should be turned on during an emergency and turned off afterwards.

USE CASE CHARACTORISTICS

- Additionally, all use cases, except for Data Networking at Emergency Scene, have the following properties:
  - Public safety applications are **one-way broadcast**. The PSOBU is broadcasting a message, which may be received (though not necessarily acted upon) by any unit within the signal area. The PSOBU does not necessarily expect a response; there is no requirement to protect a link, just an individual message.
  - Public safety applications are typically **associated with a vehicle in motion**, where running a protocol that involves multiple message exchanges increases the risk of transmission errors.
  - Public safety applications are **time-critical**. Delays due to transmission errors, cryptographic processing time, message processing time, or other reasons will greatly impact the usefulness of the system and perhaps endanger public safety.
  - Public safety applications are **medium-long range**. It is anticipated that the broadcast signal will stretch up to 1000m in front of or behind the emergency vehicle.
  - **Transactions must be completed in the shortest possible time**. As discussed in section 3.3 of this document, this implies that security messages should be as short as possible.

QUESTIONS:
Use Cases

- Are the use cases outlined in this document appropriate?
- Do you think that the RSU/OBU use case described here is useful?
- Do you expect most jurisdictions to require signal preemption/prioritization requests to go through a traffic control center, or will there be widespread use of direction preemption requests from the vehicle to the traffic signal?
- Are there other use cases that we should consider?

QUESTIONS:
Security Requirements

- Are the security requirements identified in this document for public safety applications correct?
- What security services do you expect will be provided by the radio networking stack, and what should properly be provided by the application layer?
- **How often are police cars or other emergency vehicles stolen?**
- **If an emergency vehicle is stolen the thief can use the public safety applications described here until the vehicle's key is revoked. How much delay is acceptable in revoking? For example, if for administrative reasons a vehicle cannot be removed from the system until a week has passed, is this a serious or a minor problem?**

QUESTIONS:
Provisioning/Regulatory

- Who will build PSOBUs?
- Who will take responsibility for acquiring them?
- Who will write public safety applications?
- Who will ensure that all relevant vehicles nationwide have the public safety applications installed on them?
- Will there be a standard OBU, for vehicle safety and commercial applications, and a specific PSOBU, for the public safety applications outlined here, or will there be a single OBU in each vehicle?
- Will a PSOBU be cryptographically hardened? Will it be removable from the vehicle?
- If a PSOBU is a separate device, how much do you expect safety agencies will be willing to pay per unit?

QUESTIONS:
Provisioning/Regulatory

- If a PSOBU is a separate device, do you anticipate that it will use a separate antenna from the OBU?
- Will a single unit cover the services at 2.4, 4.9, 5.9 GHz?
- Will a 4.9 GHz radio be removable from the vehicle?
- Do you anticipate that the 4.9 GHz services and the 5.9 GHz services will be merged?
- Does Project Safecom address the issue of how vehicles from different dispatchers and different emergency services are to acquire the same keys so they can communicate with each other securely? If so, how is it done?
- Who will take responsibility for certifying public safety vehicles (issuing cryptographic authentication codes)?
- Who will take responsibility for ensuring that other vehicles will be able to recognize the authentication codes? (In cryptographic terms, who will provision vehicles with root keys?)

QUESTIONS:
Provisioning/Regulatory

- Do you think revocation is best handled at the dispatcher level, or more centrally? In other words, if a device has to be removed from the system, who should be responsible for making that decision, and who should be responsible for distributing the information?
- Which authority will define transmission patterns?
- Which authority will regulate how often public safety messages (e.g. Vehicle Approach) will be sent?
- Are there existing government-defined standards for transmission security that public safety radios conform to (for example, FIPS 140-2)? Do you know of standards that they might be required to conform to?
- Do you agree that the validity of a public safety vehicle should be confined to a geographic area? How can this best be specified compactly? (For example, if the county is the appropriate geographical area, is it acceptable to define the smallest circle that encloses the county and say that the public safety vehicle's certificate is valid everywhere within that county, or are there existing unique text strings identifying every county that would be more appropriate to use?)